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(54) **A Generator**

(57) The generator comprises a turbine rotor including a hub 7, having two end portions 13, 14 and a central tubular portion 2, blades 3 extending radially outwardly from the tubular portion 2. A fixed shaft 8 is journalled in the two end portions 13, 14 and extends through one of them to support the turbine rotor 1. An electrical stator 9 is carried on the shaft 8 and an excitation magnet or magnets 6 attached to the radially inner circumference of the tubular portion 2 for rotation around the stator 9. The turbine may be driven by wind or water.

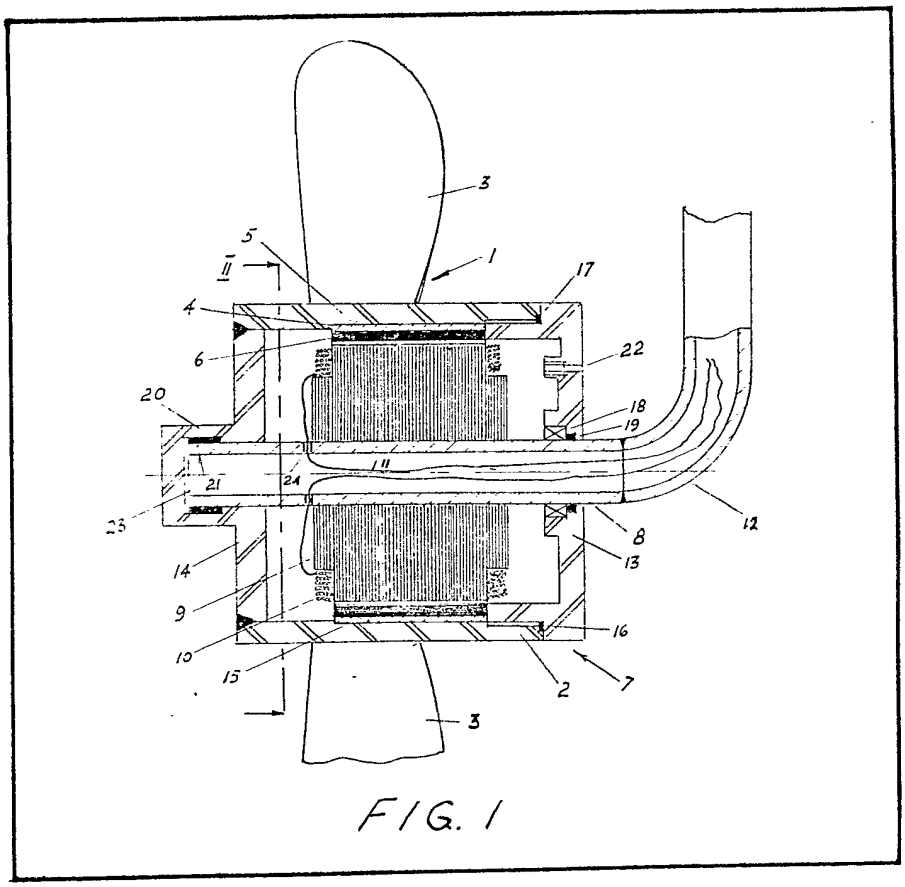

FIG. 1

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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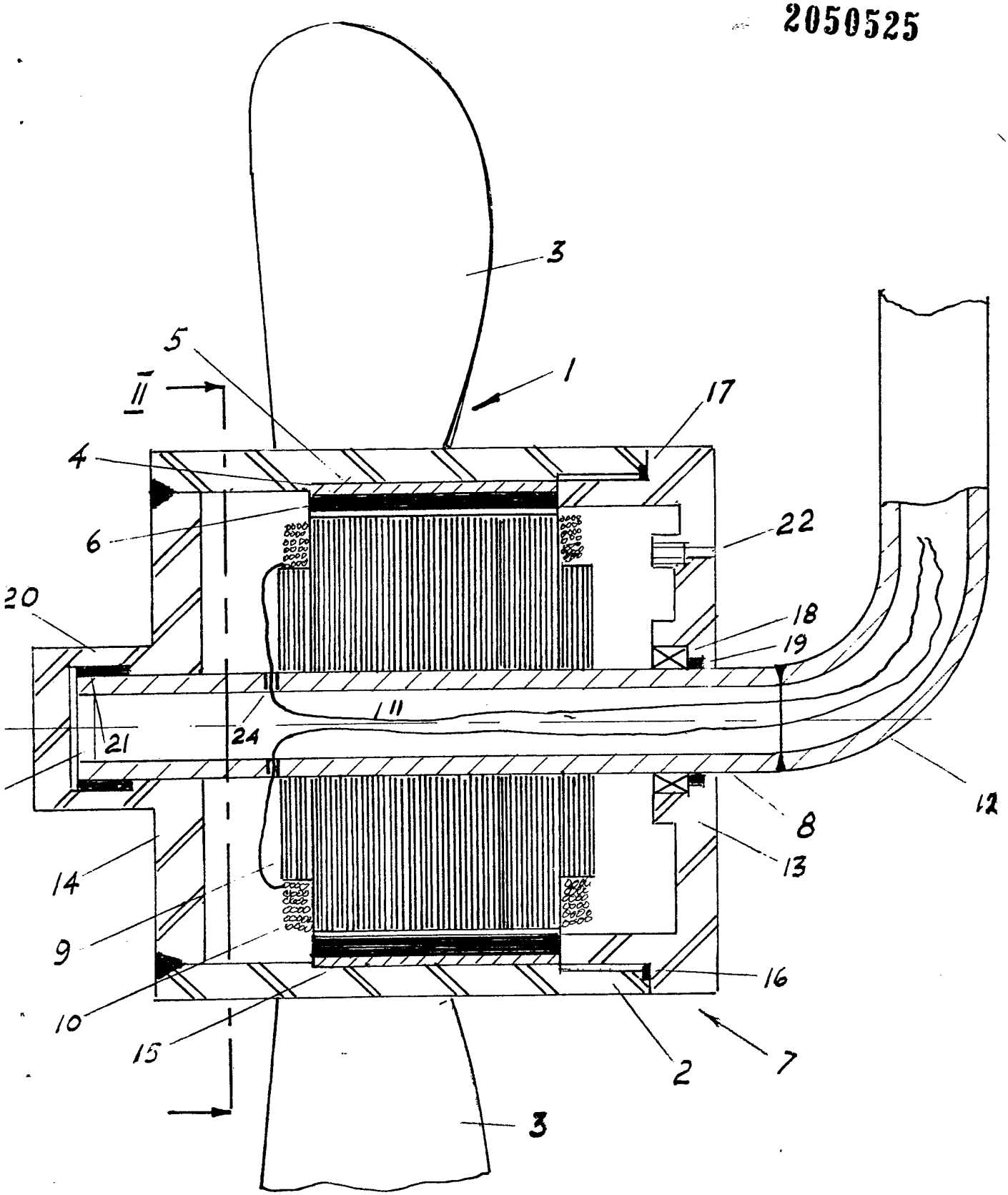

FIG. 1

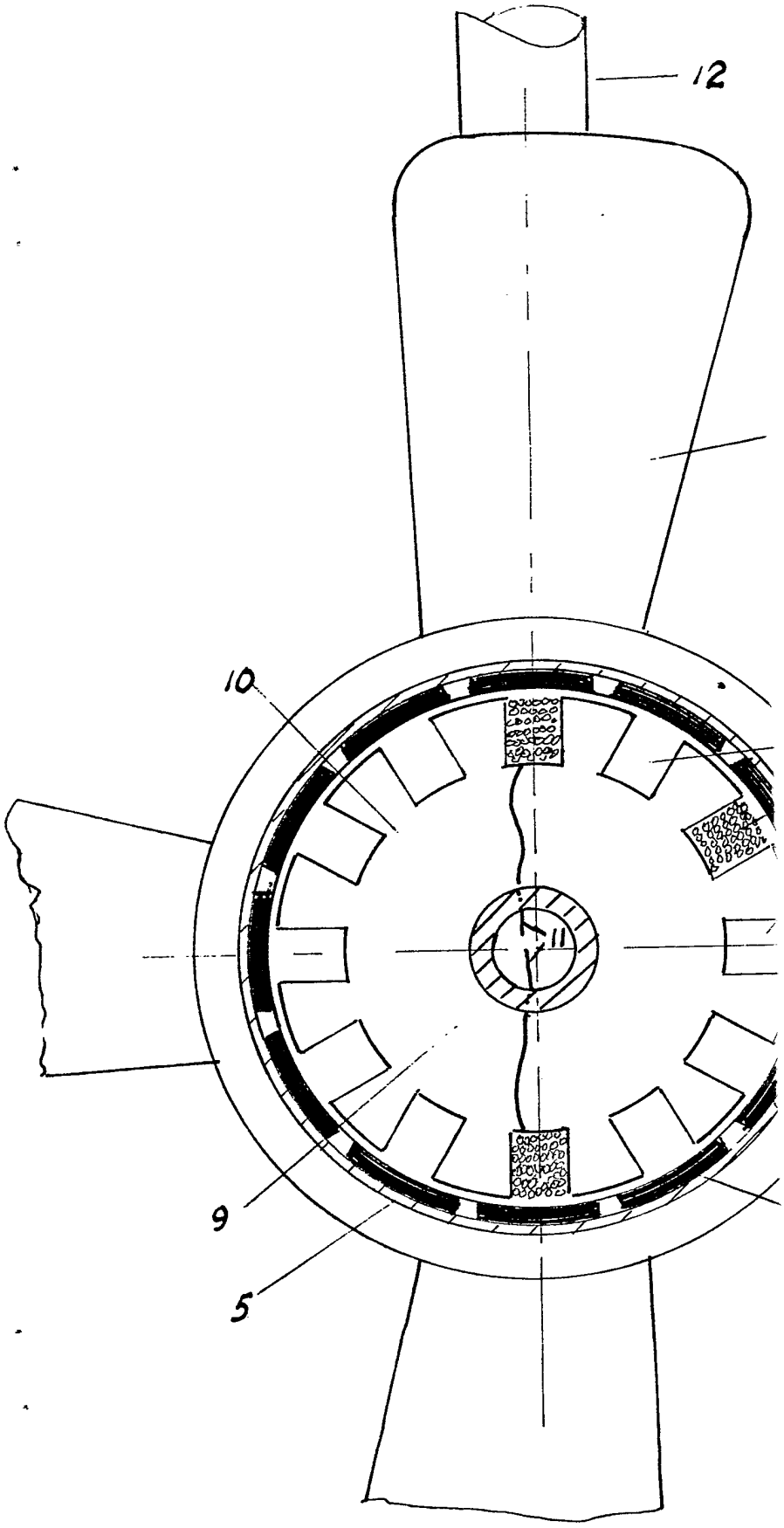

FIG. 2

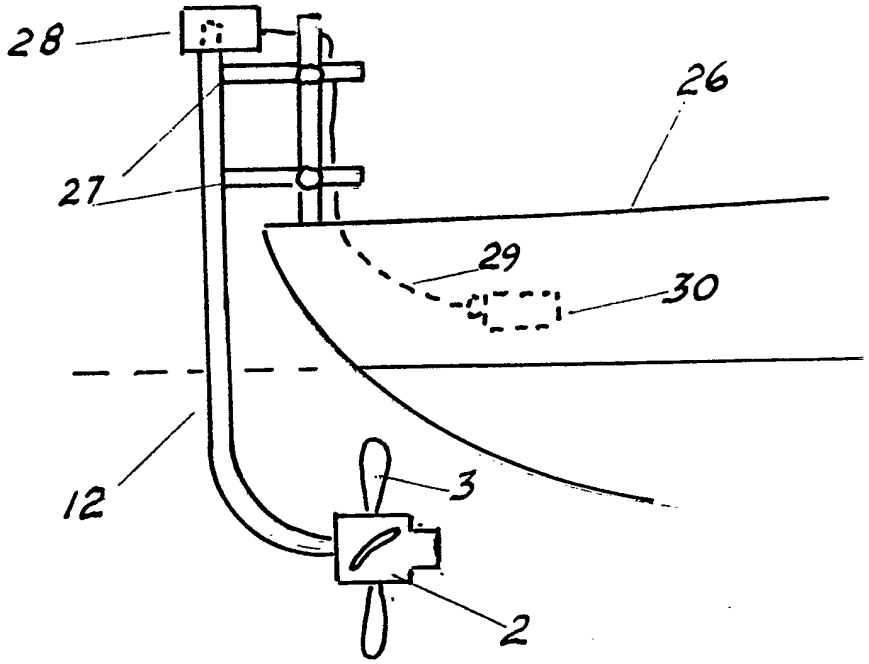

FIG. 3

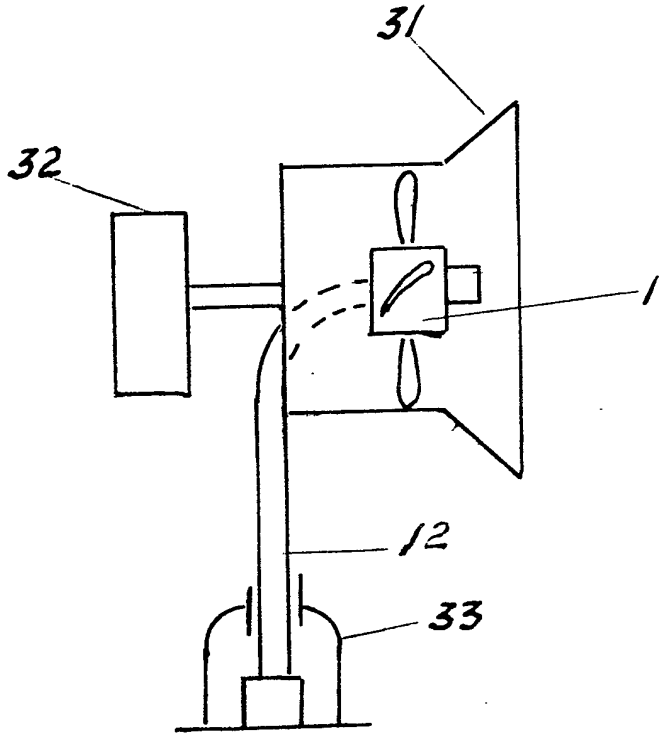

FIG. 4

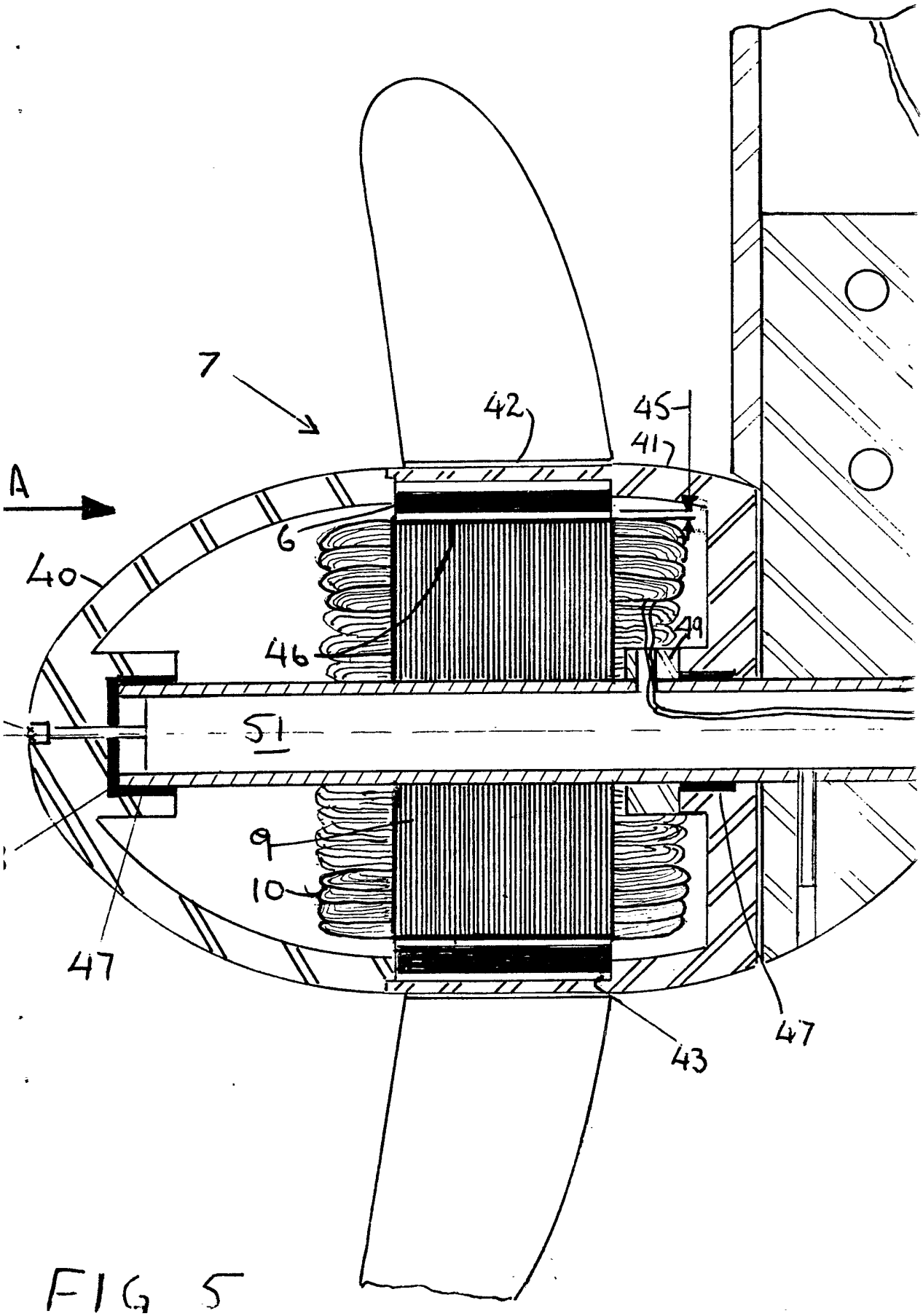

FIG 5

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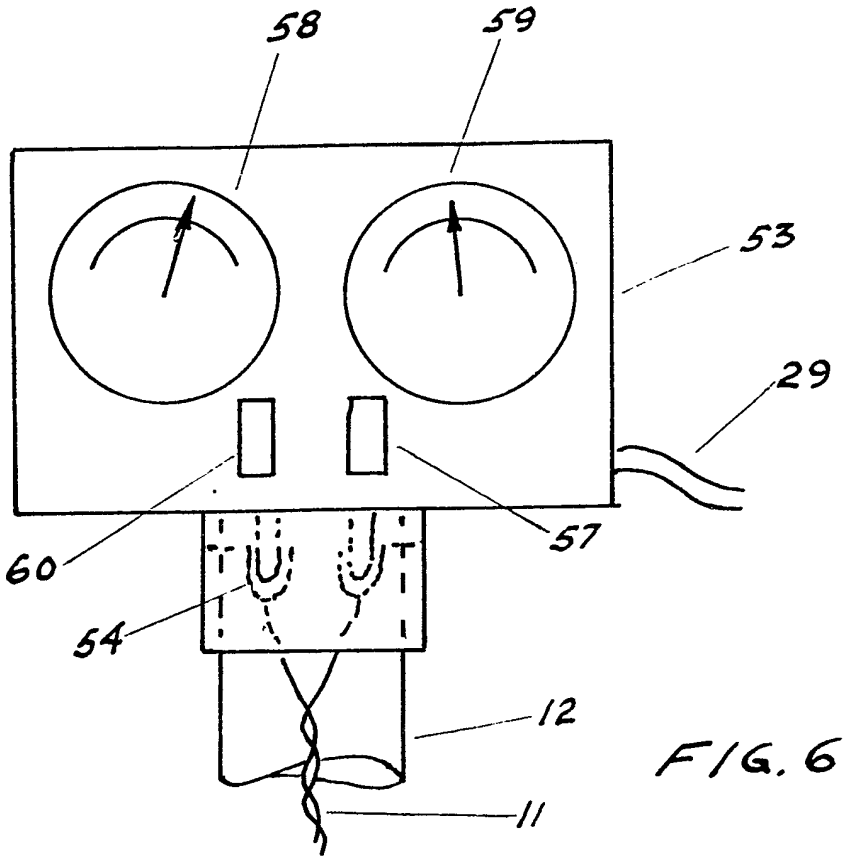

FIG. 6

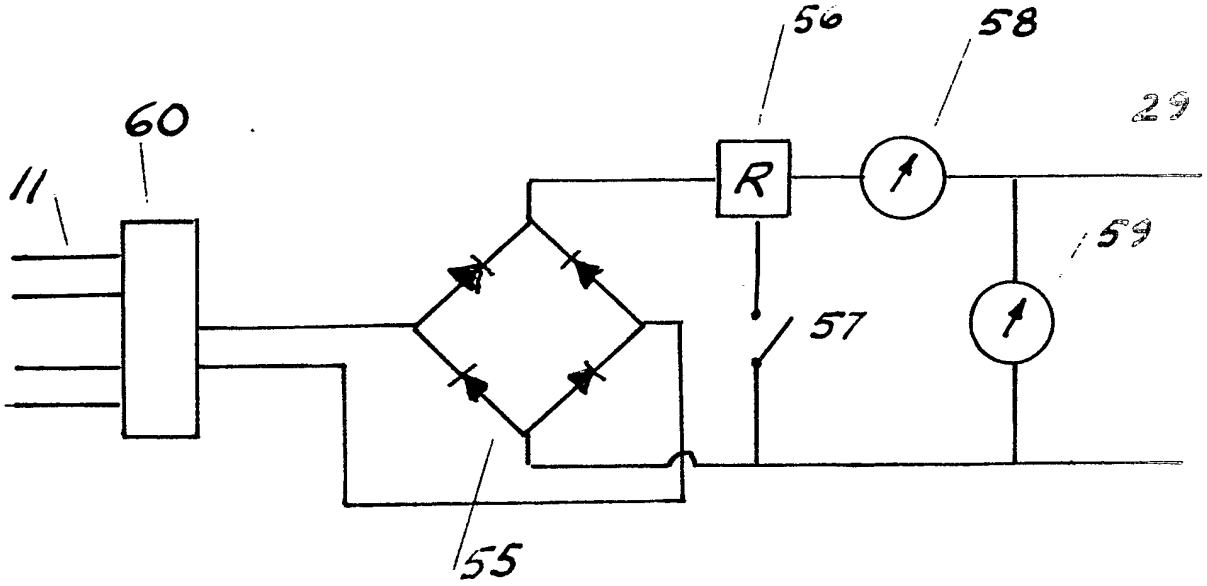

FIG. 7

SPECIFICATION

A Generator

The present invention relates to a generator for the generation of electricity from the flow of water or air or any other suitable fluid past the generator. A particular situation where electricity requires to be generated from such a flow is on board a yacht. The invention is not however solely applicable to such use.

Many yachts have engines, even if they are sailing yachts. Such a yacht can charge its batteries from its engine, but requires resonably well charged batteries to start the engine. A marine environment is conducive to unintentional discharge of batteries and there is a tendency for yachts to be left for considerable periods of time between use. Thus it is a not infrequent occurrence for yacht batteries to be flat when required. Further a yachtsman under sail may be reluctant to start his engine merely to charge his batteries. Generators for yachts are of course known.

It will be readily appreciated that it is desirable for such a yacht's generator to give a useful output from a light wind where it is wind-driven or a small speed of the yacht through the water where it is water-driven. With this consideration in mind we have sought to simplify the necessary mechanical drive connections between the generator's impeller and electrical generating apparatus.

According to the invention we provide a generator comprising a bladed impeller including a casing, having two end portions and a central tubular portion, and a plurality of blades extending radially outwardly from the tubular portion, a shaft journalled in the two end portions and extending through one of them for supporting the bladed impeller for rotation about the central axis of the tubular portion, a stator carried on the shaft and an excitation magnet or magnets attached to the radially inner circumference of the tubular portion for rotation around the stator.

The impeller may be a twisted blade propeller, or a paddle wheel. The magnets are preferably separate magnets set in a soft iron or steel ring. However an integral multipolar magnet may be used.

To help understanding of the invention, two specific embodiments thereof with modifications will now be described with reference to the accompanying drawings in which:—

Figure 1 is a part-sectioned side view of a generator according to the invention;

Figure 2 is a sectional and part-broken away end view of the generator of Figure 1 on the line II—II in Figure 1;

Figure 3 is a side view of the generator of Figure 1 in use over the transom of a yacht;

Figure 4 is a side view of the generator of Figure 1 when installed in an air-direction cowling, the cowling being shown part sectioned;

Figure 5 is a view similar to Figure 1 of another generator according to the invention;

Figure 6 is a side view of a control box for the generator of Figure 5,

Figure 7 is a circuit diagram of the control circuit; and

Figure 8 is a plan view of a modified generator having feathered blades.

Referring first to Figure 1, the generator can be seen to have a bladed impeller 1 having a central tubular portion or hub 2 and twisted impeller blades 3. The hub surrounds a soft iron ring 4 in the inner circumferential surface 5 of which are embedded permanent magnets 6. As shown thehub 2 comprises part of a casing 7 which is supported for rotation about a shaft 8. A stator 9 of iron laminas is secured to the shaft 8 and carries windings 10 from which supply leads 11 are taken via the shaft to a support post 12 at right angles to the shaft 8.

Apart from the hub 2, the casing 7 comprises two end plates 13, 14. End plate 13 is screwed to the hub to hold the soft iron ring 4 captive in a stepped bore 15 in the hub. To positively prevent the ring 4 from rotating it may be keyed or otherwise locked to the hub 2. An O ring seal 16 is provided at the casing joint 17 between the hub and the end plate 13 to ensure the watertightness of the casing. A combined thrust and journal ball bearing 18 and seal 19 are provided where the shaft 8 passes through the end plate 13. The end plate 14 is welded to the hub 2 and has a hollow boss 20 into which is pressed a plain bearing 21 to complement the bearing 18 in supporting the casing 7, and hub 2 for rotation about the shaft. The casing is oil filled through usually-blocked-off port 22. To prevent the oil escaping into the hollow shaft 8, the latter is plugged at 23 and its end within the boss 20. Where the supply leads 11 pass into the shaft, the holes 24 through which they pass are sealed. The oil within the generator prevents rust prone parts such as the soft iron ring, and the stator from coming into contact with water. The casing 7 and impeller blades 3 may be of aluminium. Alternatively the casing and blades 2 may be of moulded plastics material, possibly glass reinforced.

Turning now to Figure 2, the stator can be seen to have a number of axially extending slots 24 defining there-between pole pieces 25 around which are wound the windings 10. The magnets 6 stand proud of the soft iron ring 4 and are approximately equal in length to the pitch between the pole pieces 25. All the magnets have their magnetic axes oriented in the same circumferential direction. Thus as the casing is impelled around, the direction of magnetic flux in each pole piece changes as each pole of each magnet passes the pole piece. This leads to induction of current in the windings.

Figure 3 shows the generator in use. It is supported over the transom of a yacht 26 by the support post 12, which is clamped at 27 to the yacht. A control unit 28, for limiting the current delivered, preventing overcharging and discharging through the generator as is conventional, may be installed at the top of the

support post 12. The arrangement is such that the control unit is removably clipped to the support post for contact with the supply wires 11. Batteries wires 29 conduct charging current from the control unit 28 to a battery 30. When the generator is not required, the control unit is unclipped, so that the generator with the post 12 can be unclamped and stowed free from the encumbrances of the battery leads 29.

Figure 4 shows the generator installed for wind operation. A cowling 31, secured to the extension shaft 12, funnels the wind into the impeller 1. To keep the impeller 1 and cowling 31 facing into the wind, a vane 32 is provided attached to the down-wind side of the cowling 31. The generator/cowling is rotatably mounted at 33 so that the effect of the wind on the vane will be to turn the impeller into the wind.

Figure 5 shows another generator in accordance with the invention. The chief difference from that of Figure 1 is that no attempt is made to exclude water from the casing 7 which may be of aluminium or plastic which includes a front end 40 secured to a rear end 41 and hub 42, blades 3 extending radially outwards from the hub. Rust-resistant magnets 6, which may be "plastics magnets", are glued to a mild-steel ring 43 which at its inner circumference and ends is enclosed in moulded plastics material 44. The magnets 6 stand proud of the plastics material at the air gap 45. The outer circumference of the ring 43 is greased and a push fit in the hub 42.

The laminated stator 9 and windings 10 are enclosed in a layer of moulded plastics material 46, which extends across the stator into the air gap 45 as well as across both ends of the stator. By means of these coating layers of plastics material, for instance of epoxy resin, the stator and ring 43 are protected against corrosion.

The shaft 8 is of marine grade stainless steel. The casing is journalled on the shaft by water tolerant plain bearings 47 in bosses in the ends 40, 41 of the casing. A similar thrust bearing 48 is provided between the front end 40 and nose of the shaft. To prevent the casing slipping forwards off the shaft, an acetal bush 49 is provided between the stator which is a push fit on the shaft and the boss in the rear end of the casing.

To provide cooling for the stator, a water flow passage is provided by a gauze covered aperture 50 in the front end of the casing, a corresponding aperture in the thrust bearing 48 and an axial bore 51 in the shaft 8. In use, with water flowing past the generator in the direction of arrow A, the impeller blades turn the casing and magnets whereby electricity is generated in the stator windings. Flow of water along the bore 51 acts to dissipate heat generated in the stator.

Leads 11 pass from the stator through the acetal bush 49 into the bore 50 and out of the rear end of the shaft 8. The shaft is bolted to a peg 52 which is in turn bolted to the bottom end of the support post 12. The leads pass via a slot 55 in the peg into the post.

Figure 6 shows a control box 53 plugged onto the top of the post 12. A plug and socket joint 54 connects a control circuit within the box to the leads 11. As shown in Figure 7, the control circuit contains rectifying elements 55 and a voltage regulator 56. A switch 57 is included to switch out the regulator in the event of its failure. Then the user can oversee charging of batteries 30 by means of an ammeter 58 monitoring the charging current and a voltmeter 59 monitoring the state of the batteries. The stator is provided with two sets of windings which may be connected in series or in parallel by means of a switch 60 for charging 12 volt batteries or 24 volt batteries.

The invention is not intended to be restricted to the details of the above described generators.

As shown in Figure 8, the blades 3 may be feathered. The figure shows a blade having a base 61 extending at right angles to the blade and bedded onto the casing 7. A bolt 62 on the upstream side of the base acts as a pivot about which the blade may be feathered. A slot 63 on the downstream side accommodates another bolt 64 for locking the blade at a desired angle of attack α. Alternatively the blade may feather automatically about a pivot against the action of a spring as the water speed increases to prevent the generator from exerting excessive drag.

The impeller may be of the paddle-wheel type, with fixed or feathering blades. In this case, a cowling may be provided to obscure the blades of the impeller which are moving upstream, when the generator is intended for use totally submerged or in the air.

Where the impeller is of moulded plastics, the shaft may be of glass reinforced plastics material with ptfe bearings to enhance the corrosion resistance of the generator.

In the above described generators it can be seen there is no separate mechanical drive connection between the impeller and electrical generating apparatus. Mechanical losses in such connection are thereby avoided, which losses would otherwise decrease the overall efficiency of the generator.

Claims

1. A generator comprising a bladed impeller including a casing, having two end portions and a central tubular portion and a plurality of blades extending radially outwardly from the tubular portion, a shaft journalled in the two end portions and extending through one of them for supporting the bladed impeller for rotation about the central axis of the tubular portion, a stator carried on the shaft and an excitation magnet or magnets attached to the radially inner circumference of the tubular portion for rotation around the stator.

2. A generator as claimed in claim 1 wherein the shaft has an axial bore open at both ends for flow of cooling fluid therethrough, the other end of the casing having an aperture communicating with the hollow bore.

3. A generator as claimed in claim 1 or claim 2 wherein a seal is provided between the shaft and the one end of the casing where the shaft passes

through one end, the casing being otherwise closed and filled with oil.

4. A generator as claimed in claim 1 or claim 2 wherein the stator is enclosed in a waterproof layer of plastics material.

5. A generator as claimed in any preceding claim wherein a plurality of excitation magnets are provided and set in a soft iron or mild steel ring which is enclosed in a waterproof layer of plastics material.

6. A generator as claimed in any preceding claim including a control box including rectifying means and voltage regulating means.

7. A generator as claimed in claim 6 wherein the control box includes a switch for switching out the voltage control means, a battery state meter and a charging current meter.

8. A generator as claimed in claim 6 or claim 7 wherein the stator includes two sets of windings and the control box includes a switch for connecting the windings in parallel or series for charging 12 volt batteries or 24 volt batteries.

9. A generator as claimed in claim 6, claim 7 or claim 8 including a support post angledly connected to the shaft and the control box is removably connected to the post at a position remote from the shaft, a plug and socket connection being provided between the post and the control box.

10. A generator as claimed in any preceding claim wherein all non-electrical and non-magnetic components are of plastics material.

11. A generator as claimed in any preceding claim wherein the blades are featherable.

12. A generator substantially as hereinbefore described with reference to Figures 1 to 4 or Figures 5 to 7 or Figure 8 of the accompanying drawings.

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ASSIGNEE-INFORMATION:

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PLOT LTD C	N/A

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ABSTRACT:

The generator comprises a turbine rotor including a hub 7, having two end portions 13, 14 and a

central tubular portion 2, blades 3 extending radially outwardly from the tubular portion 2. A fixed shaft 8 is journalled in the two end portions 13, 14 and extends through one of them to support the turbine rotor 1. An electrical stator 9 is carried on the shaft 8 and an excitation magnet or magnets 6 attached to the radially inner circumference of the tubular portion 2 for rotation around the stator 9. The turbine may be driven by wind or water. □